What is Claimed:

1. Wireless radiofrequency data communication system comprising:

- a base-station comprising a multiple of N first groups and a signal processing-unit comprising memory means and processing means, wherein each first group comprises a receiver-unit provided with a receiver and at least one antenna which is connected to the receiver-unit, wherein the signal processing-unit is connected with each of the first groups for processing receive-signals generated by each of the first groups, and
- a multiple of M second groups for transmitting radiofrequency signals to the first groups, wherein each second group comprises a transmitter-unit provided with a transmitter and at least one antenna which is connected to the transmitter-unit,

wherein the memory means of the signal processing-unit are provided with means comprising information about the transfer-functions of radiofrequency signals from each of the antennas of the second groups to each of the antennas of the first groups, and wherein the transmitters and receivers operate on essentially the same radiofrequency or radiofrequency-band,

characterised in that,

the signal processing-unit is arranged to process, in use, the receive-signals on the basis of the Maximum Likelihood Detection method, such that for each second group of the second groups an individual communication channel is formed with the base-station wherein these communication channels are generated simultaneously and separately from each other.

2. Wireless radiofrequency data communication system according to claim 1,

characterised in that,

each transmitter comprises means for modulating an information signal on a radiofrequency signal according to the Quadrature Amplitude Modulation (QAM) method, wherein so-called QAM-symbols are transmitted, and that each receiver comprises means for demodulating information signals from a received radiofrequency signal.

3. Wireless radiofrequency data communication system according to claim 2,

characterised in that,

the signal processing-unit is arranged to calculate, in use, a detection signal $\mathbf{x}_{DET}$ according to

$$\mathbf{x}_{DET} = arg_{over\ set}\ min(\|\mathbf{r} - \mathbf{H}\ \mathbf{x}^{p}_{SET}\|), \qquad \mathbf{(A)}$$

where $arg_{over\ set}\ min(\|...\|)$ is a function which, according to **(A)**, yields that vector $\mathbf{x}_{DET}$ out of a set $\mathbf{X}_{SET}$ of P vectors $\mathbf{x}^{p}_{SET}$ (p=1,..,P) for which the length $\|\mathbf{r} - \mathbf{H}\ \mathbf{x}^{p}_{SET}\|$ of the complex N-dimensional vector $\mathbf{r} - \mathbf{H}\ \mathbf{x}^{p}_{SET}$ is minimal, wherein $\mathbf{r}$ is a complex N-dimensional vector $[r_1,...,r_i,...,r_N]^T$ with r_i being the signal received by the i^{th} first group of the N first groups, $\mathbf{H}$ is a complex [N * M] matrix containing transfer-functions h_{im} (i=1,...,N; m=1,...,M), wherein h_{im} is the transfer-function for transmission from the m^{th} second group of the M second groups to the i^{th} first group of the N first groups, and where $\mathbf{x}^{p}_{SET}$ is the p^{th} complex M-dimensional vector $[x^{p}_{SET,1},...,x^{p}_{SET,m},...,x^{p}_{SET,M}]^T$ of the set $\mathbf{X}_{SET}$, wherein the vectors x^{p}_{SET} in the set $\mathbf{X}_{SET}$ contain possible combinations of values which can be assigned by the second groups to an information signal $\mathbf{x}$, where $\mathbf{x}$ is a M-dimensional vector $[x_1,...,x_m,...,x_M]^T$ with x_m being the information signal transmitted by the m^{th} second group of the M second groups to the first groups and where x_m is one individual communication signal.

4. Wireless radiofrequency data communication system according to claim 3, characterised in that,

the processing unit is arranged to apply, in use, the following approximation **(B)** in the calculation of **(A)**

$$\|\mathbf{r}-\mathbf{H}\ \mathbf{x}^{p}_{SET}\| = \Sigma_{i=1,..,N}\,(\|Real([\mathbf{r}-\mathbf{H}\ \mathbf{x}^{p}_{SET}]_i)\| + \|Im([\mathbf{r}-\mathbf{H}\ \mathbf{x}^{p}_{SET}]_i)\|), \qquad \mathbf{(B)}$$

wherein $\Sigma_{i=1,..,N}(...)$ is a summation over the index i from 1 to N over the argument $(\|Real([\mathbf{r}-\mathbf{H}\ \mathbf{x}^{p}_{SET}]_i)\| + \|Im([\mathbf{r}-\mathbf{H}\ \mathbf{x}^{p}_{SET}]_i)\|)$, where $\|(.)\|$ yields the absolute value of its input argument and where *Real(...)* is a function which, in equation **(B)**, yields the real part of its complex argument $[\mathbf{r} - \mathbf{H}\ \mathbf{x}^{p}_{SET}]_i$, with $[\mathbf{r} - \mathbf{H}\ \mathbf{x}^{p}_{SET}]_i$ being the i^{th} component of the complex N-dimensional vector $\mathbf{r} - \mathbf{H}\ \mathbf{x}^{p}_{SET}$, and where *Im(...)* is a function which, in equation **(B)**, yields the imaginary part of its complex argument $[\mathbf{r} - \mathbf{H}\ \mathbf{x}^{p}_{SET}]_i$.

5. Wireless radiofrequency data communication system according to claim 4, characterised in that,

the set $\mathbf{X}_{SET}$ comprises all possible combinations of values which can be assigned to the signal $\mathbf{x}$ by the second groups.

6. Wireless radiofrequency data communication system according to claim 4, characterised in that,

the signal processing-unit is arranged to find, in use, the detection signal $\mathbf{x}_{DET}$ according to a Reduced Search Technique wherein a search-tree is passed through according to the following steps 1 to 7:

- **Step 1**: calculate the lengths of the complex vectors $\mathbf{v}$ corresponding to all combinations of possible values which can be assigned to $[x_1,..,x_L]$, wherein $\mathbf{v}$ is given by

$$\mathbf{v} = (\mathbf{r} - \Sigma_{i=1,..,L}\, \mathbf{h}_i * x^p_{SET,\, i}), \qquad \textbf{(C)}$$

  where $\Sigma_{i=1,..,L}\,(...)$ is a summation over the index i from 1 to L over the complex argument $[\mathbf{h}_i * x^p_{SET,\, i}]$ and where $\mathbf{h}_i$ is the i^{th} column $[h_{1,i},...,h_{N,i}]^T$ of the matrix $\mathbf{H}$;
- **Step 2**: select the K combinations of values for $[x^p_{SET,\,1},.., x^p_{SET,\,L}]$ corresponding to the K smallest lengths of $\mathbf{v}$ as well as the K vectors $\mathbf{v}$ itself and set $m = L+1$;
- **Step 3**: calculate the lengths of the C*K new vectors $\mathbf{v}$ given by

$$\mathbf{v} = \mathbf{v}_{old} - \mathbf{h}_m * x^p_{SET,\, m}, \qquad \textbf{(D)}$$

  where $\mathbf{v}_{old}$ is one of the K vectors $\mathbf{v}$ resulting from the preceding step and where h_m is the m^{th} column of $\mathbf{H}$;
- **Step 4**: select those K combinations of values for $[x^p_{SET,\,1},.., x^p_{SET,\,m}]$ that correspond to the K smallest lengths of $\mathbf{v}$ as well as the K vectors $\mathbf{v}$ itself and set $m = m_{old} + 1$, where m_{old} is m from the preceding step;
- **Step 5**: if $m<M$ then go to Step 3, else go to step 6;
- **Step 6**: calculate the lengths of the C*K new vectors $\mathbf{v}$ given by

$$\mathbf{v} = \mathbf{v}_{old} - \mathbf{h}_M * x^p_{SET,\, M}, \qquad \textbf{(E)}$$

- **Step 7:** the detection signal $\mathbf{x}_{DET}$ is determined as that combination of values $\mathbf{x}_{DET} = [x^p_{SET,\,1},.., x^p_{SET,\,M}]$ which corresponds to the vector $\mathbf{v}$ with the smallest length,

wherein K and L are predetermined fixed integer values which control the size P of the set $\mathbf{X}_{SET}$ and wherein the constellation size C of the system is the number of values $x^{p}_{SET,m}$ which can be assigned by one of the second groups to one component x_m (m=1,..,M) of $\mathbf{x}$ and where $\mathbf{v}_{old}$ is one of the K vectors $\mathbf{v}$ resulting from Step 3, the calculated detection signal $\mathbf{x}_{DET}$ is the combination of values $\mathbf{x}^{p}_{SET}$ corresponding to the smallest vector $\mathbf{v}$.

7. Wireless radiofrequency data communication system according to claim 4, characterised in that,

the signal processing-unit is arranged to find, in use, the detection signal $\mathbf{x}_{DET}$ according to a Reduced Search Technique wherein a search-tree is passed through according to the following steps 1 to 7:

- **Step 1**: calculate the values of the lengths of the C vectors $\mathbf{v}$ according to the C possible values $x^{p}_{SET,1}$

$$\mathbf{v} = (\mathbf{r} - \mathbf{h}_1 * x^{p}_{SET,1}), \qquad \textbf{(F)}$$

wherein $\mathbf{h}_1$ is the first column of $\mathbf{H}$;

- **Step 2**: select those combinations of values for $x^{p}_{SET,1}$ for which the lengths of $\mathbf{v}$ are smaller than T, as well as the corresponding vectors $\mathbf{v}$ and set m=2;
  - **Step 3**: calculate the lengths of the new vectors $\mathbf{v}$ given by $\mathbf{v} = \mathbf{v}_{old} - \mathbf{h}_m * x^{p}_{SET,m}$,

(G)

wherein $\mathbf{v}_{old}$ is one of the vectors $\mathbf{v}$ resulting from the preceding step and where $\mathbf{h}_m$ is the m^{th} column of $\mathbf{H}$, and adjust the treshold T;

- **Step 4**: select those combinations of values for $[x^{p}_{SET,1},\ldots, x^{p}_{SET,m}]$ for which $\mathbf{v}$ is smaller than T, discard the other combinations and set $m = m_{old} + 1$, where m_{old} is m from the preceding step;
- **Step 5**: if m<M then go to Step 3, else go to step 6,
  - **Step 6**: calculate the lengths of the new vectors $\mathbf{v}$ given by $\mathbf{v} = \mathbf{v}_{old} - \mathbf{h}_M * x^{p}_{SET,M}$,

(H)

- **Step 7:** the detection signal $\mathbf{x}_{DET}$ is determined as that combination of values $\mathbf{x}_{DET} = [x^p_{SET,1},.., x^p_{SET,M}]$ which corresponds to the vector $\mathbf{v}$ with the smallest length,

wherein T is a predetermined fixed threshold value which controls the size P of the set $\mathbf{X}_{SET}$ and wherein the constellation size C of the system is the number of values $x^p_{SET,m}$ which can be assigned by one of the second groups to one component x_m (m=1,..,M) of $\mathbf{x}$,and wherein $\mathbf{v}_{old}$ is one of the vectors $\mathbf{v}$ resulting from step 3, the calculated detection signal $\mathbf{x}_{DET}$ is the combination of values $\mathbf{x}^p_{SET}$ corresponding to the smallest vector $\mathbf{v}$.

8. Wireless radiofrequency data communication system according to claim 4, characterised in that,

the signal processing-unit is arranged to find, in use, the detection signal $\mathbf{x}_{DET}$ according to a Reduced Search Technique which at least comprises the following steps:

- **Step A1:** calculate the inner product z between the vector $\mathbf{r}$ and the u^{th} column $\mathbf{h}_u$ of the matrix $\mathbf{H}$, where u is an integer $1 \leq u \leq M$, according to:

$$z = \mathbf{h}^*_u \, \mathbf{r}, \qquad \textbf{(I)}$$

where $\mathbf{h}^*_u$ is the complex conjugated and transposed of $\mathbf{h}_u$;

- **Step A2:** calculate C^{M-1} terms Interf corresponding to all possible value combinations which can be assigned to $[x_1,...,x_{u-1},x_{u+1},...,x_M]$, wherein the terms Interf are defined according to:

$$\text{Interf} = \Sigma_{(i=1,..,M \,\wedge\, i \neq u)} \, x_i *(\mathbf{h}^*_u * \mathbf{h}_i), \quad \textbf{(J)}$$

wherein $\Sigma_{(i=1,..,M \,\wedge\, i\neq u)}$ is a summation over the index i from 1 to M with the exception of the integer u;

- **Step A3:** estimate, on the basis of the equations **(I)**, **(J)** and z' according to:

$$z' = \text{Interf} + x_u *(\mathbf{h}^*_u * \mathbf{h}_u), \qquad \textbf{(K)}$$

where z' is an approximation of z, the value for x_u corresponding to each of the value combinations $[x_1,...,x_{u-1},x_{u+1},...,x_M]$, and constitute a test set $\mathbf{X}_{SET}$ comprising C^{M-1} vectors x^p_{SET}, wherein each vector x^p_{SET} represents a value combination $[x_1,...,x_{u-1},x_u,x_{u+1},...,x_M]$;

- **Step A4:** determine the detection signal X_{DET} according to equation **(A)**, wherein the test set is defined with the C^{M-1} vectors x^{P}_{SET} from the preceding step.